paratively of modern construction; it has, however, been the practice during the last few years, to form the junctions with cants, and in some instances with curves, both being in a direction in accordance with the flow of the streams. From the very frequent opportunities I have of examining the condition of sewers, I have found vast numbers, indeed I may say, as before observed, whole districts of them more or less choked with decomposed matter, and this naturally led me to inquire into the probable causes of their inefficiency; and from having well examined into the causes of these deposits and accumulations, I am convinced that they are produced almost entirely from the improper form, arrangement, and exaggerated sizes of the sewers.

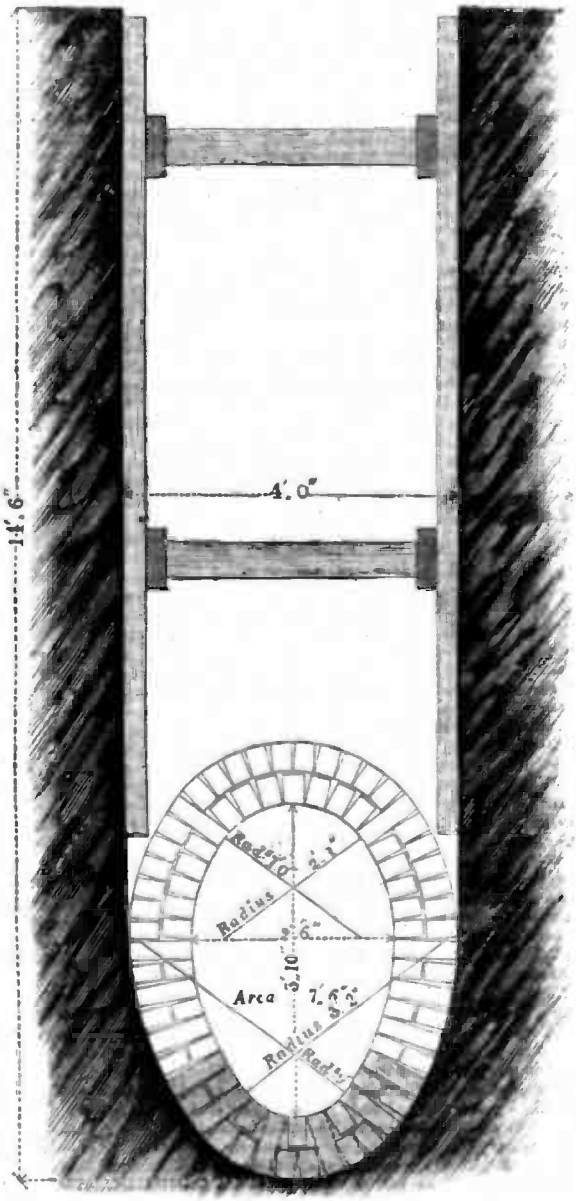
It has been the practice to build what are termed first and second class sewers; and it would appear that precisely the same size and form of sewer has been laid down in numberless instances for draining short streets containing from twenty to fifty houses as have been built for the purpose of receiving the whole of the drainage from collateral districts. The great absurdity of this regulation has long been apparent and has frequently formed a proper cause of complaint. This system has been the cause, by the great and unnecessary expense, of preventing many densely populated localities from being properly drained, many persons being led to seek drainage either surreptitiously or by cesspools, and the permeability of the adjacent ground. Nearly the whole of the water which is discharged into these disproportionately large and short sewers, from the number of drains being few, passes off very slowly, leaving the soil behind, which, as it accumulates from time to time, ultimately stops up the sewer and the private drains as well; consequently the soil has to be removed from them at great trouble and expense; which process has again and again to be repeated as they become choked up. It has been a regulation never to build sewers of less size than is sufficient to allow a man to pass freely along them; and it would appear that this has been the cause in a very great degree of the large sizes which have been adopted and continued for so long a time, consequently the form which would have accelerated the flow and prevented soil from accumulating within them, has not been generally adopted. Now, by judicious arrangements, a proper size can always be retained for that purpose, and, at the same time, the form and width of the inverts may be enlarged or contracted suitable to any exigency or discharge of water and sewage that may be required for any particular locality.

Much controversy has arisen at various times respecting the best and proper transverse form for a sewer, and several forms, both rectangular, elliptical, and circular, with sometimes portions of these shapes blended together, have been suggested and used accordingly. But it would seem that the main question as regards strength and efficiency for discharging the sewage, has been by many persons, either misunderstood or entirely overlooked. Now it must be manifest to all that sewers should be arranged and constructed so as to facilitate the rapid passage of the soil to their outlets, it should therefore always be a question, whenever a sewer is required to be put in, whether its arrangement of size, form, and fall, is calculated to impart sufficient velocity and scouring action to the water so as to carry off or prevent the soil from becoming deposited upon its bed. Now, if the data for the proper size, form, and fall for a sewer be not ascertained, and these properly proportioned to the volume of water likely to find its way into it, the chances are that the force of the stream, from being extended, will not be sufficient to remove the soil, consequently it will accumulate, and the sewer will ultimately become choked, and close up each house-drain.

Economy combined with the utmost efficiency are the principal considerations which should be observed in the formation of sewers; and it is remarkable that the best form that can possibly be adopted is not only the most economical and durable, but is also the most efficacious in carrying off the sewage matter. Besides it combines in its formation the greatest strength with the least consumption of material, and is at the same time strictly conformable to both static and hydraulic principles. I strongly recommend for adoption the annexed section for sewers, being persuaded from a strict examination of the principles of such structures, that it combines in its form great strength and power of resisting vertical and lateral pressure, economy of labour and materials, and facilities for ensuring good, sound, and durable workmanship; but above all, and which is of the utmost importance, it affords great advantage to the velocity and scouring action of water, even when its quantity may be small; and without which advantages no structure of this nature can be effectual for the purpose of carrying off the drainage and sewage. Although this shape is an approximation to the form of sewer now in use in the Holborn and Finsbury divisions, still I believe it is rather better calculated to sustain pressures from the ground, and to impart greater velocity and inciting force to a given body of water; for the frictional surface of its invert is less, consequently the hydraulic mean depth of the water would be greater than is afforded by that form; and, according to the principles of hydraulics, the velocity and power to scour increases in proportion to the square root of the height of the water. From being subjected to considerable forces, and in order to sustain them, sewers should always be of the annexed form, or arranged upon similar principles. I shall now proceed to examine the nature of those forces and their mode of action.

When an upright cutting is made in the ground, the adjacent earth at the sides is dependent for its stability upon the nature of the soil and the power of cohesion which binds the aggregated particles to each other, as also on the dip or natural inclination which each succeeding underlying joint and stratum take with the horizon. The particles of ground from the surface downward differ more or less in their relative sizes and shapes, and are upborne and supported by those which lie directly underneath and contiguous to them, consequently their pressures are diffused in lateral, oblique, and perpendicular directions. Now, the lateral pressure which was afforded by the ground in the trench to that at the sides before it was excavated, becomes entirely destroyed, and if the tenacity or cohesive power which connects the particles together be not equal to the lateral force acting *from* them, the masses will break and crumble

IMPROVED FORM OF SEWERS.



The dark portion of the brickwork to be in cement.

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